REMARKS

Claims 1-34 and 36 is pending in the application. Claims 1-34 have been previously withdrawn. Upon entry of this paper, claim 36 is amended. Support for the amendment can be found throughout the Specification and specifically at page 17, second paragraph; page 7, last paragraph, Figures 10A and 10B of the Specification. No new matter is added. Applicants respectfully submit that the pending claims define over the art of record.

I. Interview with the Examiner

Applicants thank the Examiner and Supervisory Examiner for the courtesy of an interview on May 28, 2009. During the interview, Applicants' representatives discussed the elements of claim 36 with respect to Figures 10A and 10B of the Present Application. In particular, Applicants' representatives noted that the controller determines an expected output current (I_2) in response to a signal indicative of a driving state of the vehicle (e.g., depressing the accelerator pedal). Based on this expected output current (I_2), an excess supply amount of the reacting gas is determined. The excess supply amount of the reacting gas is supplied to the system when the output current is still equal to an initial current amount.

Applicants' representatives explained to the Examiner that the controller determines an expected output current (I_2) when the user changes the driving state of the vehicle. *See* Present Application, page 7, last paragraph. Based on this expected output current (I_2), an excess supply amount of the reacting gas is determined. *See* Figures 10A-10B. The excess supply amount of the reacting gas is supplied to the system when the output current is still equal to I_1, i.e. in advance of a variation in the electrical load occurs. *See* Present Application, page 17, second paragraph.

Applicants amend claim 36 and provide additional remarks to address the Examiners' concerns as discussed during the interview.

II. Amendments to claim 36

Based on the discussion with the Examiners during the interview, claim 36 is further amended to recite supplying the reacting gas in an amount which includes the excess supply

amount in addition to an equilibrium reacting gas supply amount ($Qa_{1'}$) <u>when the output current of the fuel cell corresponds to the first output current (I_1)</u>. Support for this amendment may be found at page 17, second paragraph of the Present Application. Applicants also amend claim 36 to recite determining an expected output current (I_2) <u>based on one or more input signals indicative of acceleration of the vehicle</u>, as illustrated in the enclosure. Support for this amendment may be found at page 7, last paragraph of the Present Application.

III. Overview of the Claimed Invention

Applicants initially note that the claimed invention is <u>not</u> a technology of merely supplying more reactant gas in a conventional fuel cell system. Rather, the claimed invention provides a way to supply an accurate supply amount of reaction gas in the special case in which the <u>fuel cell</u> and the <u>capacitor</u> are directly connected to each other. The claimed invention recites the special case in which the fuel cell and the capacitor are directly connected. In this special case, in order to determine an accurate amount of reaction gas to be supplied to the fuel cell, the skilled artisan needs to consider whether an excess supply amount of reaction gas is necessary. As a result, oversupply and undersupply of the reaction gas can be prevented. Thus, the claimed invention prevents the deterioration in the fuel cell performance due to a shortage of the reaction gas and a reduction in the fuel-efficiency due to oversupplying the reaction gas more than the necessary excess supply amount.

Applicants respectfully submit that the cited reference neither discloses nor suggests a way of supplying an accurate supply amount of the reaction gas to a fuel cell in the special case in which the fuel cell and the capacitor are directly connected.

IV. Remarks addressing Examiners' questions raised during the interview

The Examiner indicated two concerns regarding the claimed invention. The Examiner's first concern is directed to what happens to the excess supply amount of the reactant gas at the time when the output current of the fuel cell corresponds to I_2 and beyond. Specifically, the Examiner inquired about whether a particular excess supply amount of reactant gas (once determined) is constantly provided to the fuel cell system.

Applicants respectfully submit that, contrary to the Examiner's interpretation, the claimed invention does not merely disclose supplying more (i.e., excess) reactant gas than conventional fuel cell systems. Specifically, a *constant* excess supply amount of reactant gas is not supplied to the system. In the claimed invention, an amount corresponding to the *required* excess supply amount of reactant gas to be supplied to the system is *calculated* in real-time at a number of given or different equilibrium points.

According to the claimed invention, it is possible to accurately supply a particular amount of reaction gas (i.e., excess amount) when a fuel cell and a capacitor are *directly* connected. As a result, oversupply and undersupply of the reaction gas can be prevented, thereby preventing deterioration in the fuel cell performance due to a shortage of the reaction gas and a reduction in the fuel-efficiency due to oversupplying the reaction gas more than the necessary excess supply amount of reaction gas.

To address the Examiner's first concern, Applicants submit herewith an Appendix (with Appendices A-D) illustrating the calculation of a particular excess supply amount of the reaction gas with reference to, for example, three different equilibrium points. Once this amount is calculated, it is supplied until a new amount is calculated, which occurs in real time. Applicants respectfully submit that these examples are provided using Figures 10A and 10B of the Present Application for ease of explanation. FIGS. 10A and 10B of the Present Application illustrate a method of *calculating* the *adequate* excess supply amount of reaction gas for use by the system. Figures 11A and 11B of the Present Application illustrate the actual relationship between the output voltage and the output current, and the actual relationship between the reaction gas supply amount and the output current. As it is easier to work with linear graphs, Applicants illustrate the examples using the approximation graphs illustrated in Figures 10A and 10B.

Specifically, Appendix A illustrates a first equilibrium point U when Ifc = I1; Appendix B illustrates a second equilibrium point U' when Ifc = I1+α; Appendix C illustrates a third equilibrium point U'' when Ifc = I1+β. Appendix D illustrates these equilibrium points in a graph representing the actual current-voltage characteristics of the fuel cell.

As illustrated in Appendix A, at the equilibrium point U, the current of the fuel cell is I_1 and the corresponding voltage of the fuel cell is V_1. A synthetic current-voltage characteristic

graph is plotted from the equilibrium point U. When the output current Ifc is changed from the electrical load I_1 for a *predetermined load change width* ΔI (allowable current variation width), the output current Ifc becomes I_2. The output voltage V_2 that corresponds to the output current I_2 is calculated using the synthetic current-voltage characteristic graph. Using the current-voltage characteristic graph of the fuel cell provided on Figure 10A, the current of the fuel cell after the variation of an electrical load would be Ifc_2'. The new reaction gas supply amount can be determined with reference to the equilibrium output graph corresponding to the current V_2 on the current-voltage characteristic graph of the fuel cell. Now referring to Figure 10B, the reaction gas supply amount that corresponds to the output current Ifc_2' on the reaction gas supply amount at equilibrium output graph would be Qa_1. Please note that Qa_1 is greater than $Qa_{1'}$. The difference between Qa_1 and $Qa_{1'}$ is the calculated *excess* supply amount. This increased amount, i.e. Qa_1, is supplied to the system when the output current is equal to I_1, which is before the variation of an electrical load occurs. In conventional systems, when the output current is equal to I_1 the system would normally require only the reaction gas supply amount $Qa_{1'}$. However, according to the present invention, the increased reaction gas amount of Qa_1 is supplied to the fuel cell instead. The skilled artisan will readily recognize that the difference between $Qa_{1'}$ and Qa_1 corresponds to the excess supply amount. By supplying the exact amount of excess reaction gas supply before the electrical load varies improves the overall fuel cell performance. Applicants respectfully note that this excess supply amount is used by the system at this time (I_1) and that a new excess supply amount will be determined at a later time based on system needs, in real time. As a result, the deterioration in the fuel cell performance due to a shortage of the reaction gas is prevented. In addition, a reduction in the fuel-efficiency due to oversupplying the reaction gas more than the necessary supply amount of reaction gas is prevented.

The equilibrium point U is merely an equilibrium point that corresponds to the electrical load I_1 which is before a variation in the electrical load actually occurs. If a new electrical load before variation is now assumed to be $I_1+\alpha$, then the equilibrium point U would be moved along the current-voltage characteristic curve to a different point. The system then calculates a new reaction gas excess supply amount. As illustrated in Appendix B, this point is denoted as the second example equilibrium point U'. The synthetic current-voltage characteristics graph (dotted line) that is plotted using the second example equilibrium point U' is lower than the

synthetic current-voltage characteristics graph that corresponds to the first example equilibrium point U. The current-voltage characteristics of the fuel cell (solid line in FIG. 10A) and the reaction gas supply amount characteristics at an equilibrium output (solid line in FIG. 10B) do not change, i.e. the solid lines illustrated in Figures 10A and 10B are the same. Then, similar to the techniques illustrated in Appendix A, the excess supply amount is determined by tracing $I_1+\alpha \Rightarrow I_1+\alpha+\Delta I = I_2+\alpha \Rightarrow \ldots$. The new reaction gas amount Qa_2 is obtained. Please note that the obtained reaction gas amount Qa_2 is larger in this example than Qa_1. That is, the point ($I_1+\alpha$, Qa_2) would be moved to the more right and upper side than the point (I_1, Qa_1) in FIG. 10B. This excess supply amount ($Qa_2 - Qa_{2'}$) would now be supplied at $I_1+\alpha$ along with the initial supply amount $Qa_{2'}$ that would have been supplied when the current load is equal to $I_1+\alpha$. Please note that this excess supply amount ($Qa_2 - Qa_{2'}$) does <u>not</u> have to be the same as the previous excess supply amount ($Qa_1 - Qa_{1'}$).

Appendix C illustrates a third example equilibrium point U''. Same as above, when β, which is larger than α, is assumed to obtain the point ($I_1+\beta$, Qa_3), this point ($I_1+\beta$, Qa_3) would be located at the more right and upper side in FIG. 10B. Then, by connecting the points (I_1, Qa_1), ($I_1+\alpha$, Qa_2), ($I_1+\beta$, Qa_3), ..., the reaction gas supply amount characteristics (dotted line) can be obtained.

Along the reaction gas supply amount characteristics curve, the reaction gas supply amount Qa_1 is supplied when the electrical load before variation is I_1; the reaction gas supply amount Qa_2 is supplied when the electrical load before variation is $I_1+\alpha$; and the reaction gas supply amount Qa_3 is supplied when the electrical load before variation is $I_1+\beta$. Although the explanation in Appendices A-C is somewhat simplified, further detail is also shown in Appendix D.

The excess reaction gas supply amount is added to the equilibrium reaction gas supply amount at the corresponding time. For example, in the first example illustrated in Appendix A, the excess reacting gas supply amount is added to the equilibrium reaction gas supply amount at the time of I_1, when the load current is I_1. Similarly, in the second example illustrated in Appendix B, the excess reaction gas supply amount is added to the equilibrium reaction gas supply amount at the time of I_2, when the load current of I_2.

As explained in connection with the foregoing examples, according to the present invention, a first excess supply amount of reaction gas is calculated at a first equilibrium point. The first excess supply amount of reaction gas is supplied to the fuel cell system at the first equilibrium point and is used by the system. The system continues operating and then determines a second equilibrium point. A second excess supply amount of reaction gas corresponding to this second equilibrium point is calculated by the system. The second excess supply amount of reaction gas is different from the first excess supply amount of reaction gas. The second excess supply amount of reaction gas is supplied to the fuel cell system at the second equilibrium point and is used by the system. Therefore, the claimed invention does <u>not</u> merely supply a constant level of the same excess supply amount of reaction gas to the fuel cell system, but rather determines the precise amount of excess reaction gas needed by the system at any given time, in real-time. The system is not designed to calculate a single excess supply amount of reaction gas, which is then constantly supplied regardless of system conditions. Specifically, the claimed invention *calculates* the excess reaction gas amount needed for each different equilibrium point, and then supplies the corresponding excess supply amount of reaction gas at the corresponding equilibrium point.

Applicants believe that the foregoing remarks address the Examiner's first concern. Specifically, Applicants respectfully submit that a constant amount of excess reacting gas is <u>not</u> supplied to the system at all times. Rather, a required excess reacting gas amount is calculated at given points, and the calculated excess reacting gas amount is supplied to the system along with the initial reacting gas supply amount. This prevents decay of the fuel cell performance due to reacting gas shortage. Since the required amount is calculated as illustrated in the enclosures, the claimed invention further prevents oversupplying of reacting gas to the system.

The Examiners' second concern is that the illustrated example and the claims themselves appear to only cover an increase in the output current, i.e. when the user accelerates. The Examiner indicated that the specification explains the variation in electric load as being an increase. However, the Examiner asserts that the specification does not provide support for a decrease in the electrical load.

Applicants amend claim 36 to clarify that the claim addresses the acceleration of the fuel cell vehicle. Applicants believe that this amendment addresses the Examiner's second concern.

V. Claim Rejections under 35 U.S.C. § 112

1. Claim rejections under 35 U.S.C. § 112, first paragraph

Claim 36 is rejected under 35 U.S.C. § 112, first paragraph, because the Examiner asserts that the Specification while being enabling for the variation in electrical load increasing, does not reasonably provide enablement for the variation in electrical load decreasing.

Applicants respectfully submit that amended claim 36 no longer recites a variation. Rather, amended claim 36 recites *determining an expected output current (I_2) based on one or more input signals indicative of* ***acceleration*** *of the vehicle*, as discussed during the interview. Applicants respectfully note that, as indicated by the Examiner, the Specification is enabling for the variation in electrical load increasing, i.e. when the vehicle accelerates.

Applicants believe that the amendments address the Examiner's concerns. Accordingly, Applicants respectfully request the Examiner to reconsider and withdraw the rejection of claim 36 under 35 U.S.C. § 112, first paragraph.

2. Claim rejections under 35 U.S.C. § 112, second paragraph

Claim 36 is rejected under 35 U.S.C. § 112, second paragraph, as being indefinite. Specifically, the Examiner asserts that the limitation "in advance of a variation in an electrical load" is indefinite because it doesn't distinctly disclose a time for "in advance". The Examiner further asserts that the timeline for the method of operating the fuel cell is awkward and unclear and as such is not distinctly claimed. The Examiner asserts that the controller supplies excess reactant "in advance of a variation in an electrical load" by "determining an expected output current after the variation in the electrical load".

Applicants amend claim 36 to delete the limitations "in advance of a variation in an electrical load" and "after the variation in the electrical load". Applicants believe that the amendments address the Examiner's concerns. Accordingly, Applicants respectfully request the

Examiner to reconsider and withdraw the rejection of claim 36 under 35 U.S.C. § 112, second paragraph.

VI. Claim Rejections under 35 U.S.C. § 103

Claim 36 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Kimura *et al.* (5,964,309) in view of JP 08-214452 (Takeshi). Applicants respectfully traverse the rejection based on the foregoing amendments and the following argument.

Applicants respectfully submit that Kimura and Takeshi, alone or in any reasonable combination, do not teach or suggest *supplying the reacting gas in an amount which includes the excess supply amount in addition to an equilibrium reacting gas supply amount* ($Qa_{1'}$) *when the output current of the fuel cell corresponds to the first output current* (I_1), as provided in Applicants' amended claim 36.

As provided above, the claimed invention provides a way to supply the accurate supply amount of the reaction gas in the special case in which the fuel cell and the capacitor are directly connected. According to the claimed invention, when the fuel cell and the capacitor are directly connected, the accurate amount of the reaction gas can be supplied with consideration of the necessary excess supply amount. According to Applicant's amended claim 36, the excess supply amount of the reacting gas is determined based on the supply amount of reacting gas (Qa_1) corresponding to the second output current ($I_{fc2'}$). The determined excess supply amount of the reactant gas is supplied *in addition to an equilibrium reacting gas supply amount* ($Qa_{1'}$) *when the output current of the fuel cell corresponds to the first output current* (I_1).

Applicants respectfully submit that the combination of the cited references do not teach or suggest these claim elements. Specifically, the cited references do not teach or suggest *supplying the reacting gas in an amount which includes the excess supply amount in addition to an equilibrium reacting gas supply amount* ($Qa_{1'}$) *when the output current of the fuel cell corresponds to the first output current* (I_1) in a fuel cell system where *the fuel cell and the capacitor are directly connected*, as recited in Applicants' claim 36.

The Examiner cites the Takeshi reference merely for the teaching of a capacitor. On the other hand, the Kimura reference discusses determining gas supply amount that corresponds to the total amount of load indicated by the power supply system. The system of the Kimura reference then determines whether the storage battery is in charging condition. If the storage battery is in charging condition, the system calculates the total amount of electric power to be supplied by the fuel cells, by taking into account the amount of electric power required for charging the storage battery. The system then corrects the gas supply amount to be supplied to the fuel cells. If, on the other hand, the storage battery is determined to be in the discharging condition, the control unit supplies the previously determined, i.e. not corrected, amount of gas to the fuel cells. *See* Figure 7 and Col. 16, lines 33-65. However, the Kimura reference, alone or in any reasonable combination with the Takeshi reference, does <u>not</u> teach supplying *the reacting gas in an amount which includes the excess supply amount in addition to an equilibrium reacting gas supply amount* ($Qa_{1'}$) *<u>when the output current of the fuel cell corresponds to the first output current</u>* <u>(I_1)</u>, in a fuel cell system where *the fuel cell and the capacitor are directly connected*, as provided in Applicants' amended claim 36.

In light of the foregoing remarks, Applicants respectfully submit that the Kimura and Takeshi references, taken either alone or in any reasonable combination, do not teach or suggest each and every element of Applicants' amended claim 36. Accordingly, Applicants respectfully request the Examiner to reconsider and withdraw the rejection of claim 36 under 35 U.S.C. § 103(a).

CONCLUSION

In view of the above amendment, applicant believes the pending application is in condition for allowance.

Please charge any shortage or credit any overpayment of fees to our Deposit Account No. 12-0080, under Order No. SIW-022RCE3. In the event that a petition for an extension of time is required to be submitted herewith, and the requisite petition does not accompany this response, the undersigned hereby petitions under 37 C.F.R. § 1.136(a) for an extension of time for as many months as are required to render this submission timely. Any fee due is authorized to be charged to the aforementioned Deposit Account.

Dated: August 3, 2009

Respectfully submitted,

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